Observing System Research Studies

D.E.Harrison
NOAA Pacific Marine Environmental Laboratory, Seattle, WA

Project Summary

This project supports the design, evaluation and development of the global ocean observing system for climate through a variety of research activities. These activities include data set preparation/dissemination, data analysis and modeling studies. The goal is to expand our knowledge of what we know and can rationalize, and what we cannot know or rationalize, from the observing system as deployed at present and from the historical data set that has been produced over past decades. It also supports the evolution of the observing system through evaluation of alternative observing strategies and evaluation of the differences between available ocean analysis products (taken as one measure of the uncertainty in the analysis products).

Finally it supports the goals of the Office of Climate Observations and NOAA's Climate Goal through the PI's activities as Chair of the Ocean Observations Panel for Climate (co-sponsored by the GOOS, GCOS and WCRP) and other national and international leadership activities involved with sustained ocean observing. The PI is also a member of the JCOMM Management Committee and works with its Program Areas to progress the development and delivery of global ocean services.

No data are collected through this project; the Ten Climate Monitoring Principles are not relevant to the activities undertaken.

Initial focus has been on SST variability since it is agreed to be the most important variable for climate impacts. Work has been done with all of the variables of the global ocean observing system, and shall continue in FY08 as described below.

No Add Task support is requested for FY08.

Accomplishments FY 2007

We have shown, through examination of the ocean historical data set, that there is very strong space and time variation in decadal trends of upper ocean temperature. The variation on this time scale is of sufficient magnitude to dominate the 50year trend in many regions. This means that, to the extent that upper ocean temperature trends are important to future SST anomaly evolution we may expect ocean decadal variability to contribute more to climate variability over the next decades than the contribution from global warming.

Our work also questions whether recently published estimates of long term trends of world ocean heat content are accurate enough to be useful useful, because so much of the world ocean has not been observed adequately to permit a meaningful trend estimate to be made. We showed that differences in the interpolation techniques used to produce a global "data set" have very substantial effects on the inferred global 50year trend. This works makes once again the case that obtaining and maintaining global coverage of in situ observations is critical for accuracy of long term world ocean trends.

We showed that the seasonal climate influence of ocean surface conditions are more substantial over the NW Americas and particularly Alaska than had been reported, but that it is necessary to consider jointly the state of the Arctic Oscillation and ENSO; considering either separately leads to the appearance of less weather impact.   The joint impact is not the sum of the separate impacts. Better understanding of the predictability of the Arctic Oscillation is important; predictability may be better than has been thought based on our autocorrelation statistics, but the mechanisms responsible for this remain to be elucidated.   This work argues for the importance of observations to understand better the Arctic Oscillation.

We showed that knowledge of meridional surface wind anomalies is as important as knowledge of surface zonal wind anomalies in the creation of Indian ocean SST anomalies that are thought to affect southern Africa weather. The surface heat flux contribution of meridional advection of surface humidity can dominate zonal advection in the regions of interest, contrary to previous suggestions. The latent heat flux anomaly is a key element of the evolution of SST anomalies on the basin scale.
We showed that it is possible to understand the differences in tropical North Atlantic SST anomalies in the 'hurricane alley' formation regions between 2005 (lots of hurricanes) and 2006 (few hurricanes) by considering differences in the large scale atmospheric circulation over the region, and the resulting changes in air-sea heat fluxes. It is not necessary to invoke changes in the atmospheric loading of aerosols off of west Africa to rationalize the observed SSTA patterns. These latter papers show once again how important accurate knowledge of air-sea fluxes is for understanding (and predicting) SST anomalies of climate relevance; the observing system activities that serve to help us evaluate operational air-sea flux estimates are very important.

Finally we showed that there has been a change in the wind patterns associated with westerly wind events over the tropical Pacific since the major 1997-98 El Nino event, and that these seem sufficient to explain why we have been having more 'Dateline El Nino' than 'conventional El Nino' events since then. We used numerical ocean model experiments to obtain the latter conclusion. This work suggests a new index might be developed for tracking the likelihood of an El Nino appearing in any given year; investigation of this will be a priority for FY08.

International and national ocean observing system leadership work, primarily as Chair of the Ocean Observations Panel for Climate (co-sponsored by the Global Ocean Observing System program, the Global Climate Observing System program and the World Climate Research Program) and as Chair of the Climate Observing System Council, continued during FY07.

It was primarily a year of consolidation and follow-through for global ocean observing system activities. After several years of developing and agreeing international plans and pilot projects, several years of hard work like FY07 lie ahead as these continue to be taken forward. Implementation of the observing system itself continued, but at a reduced pace; development of ocean services and ocean analysis and reanalysis continues; development of the real time ocean metadata system is progressing. A major new effort is underway to engage better the ocean biogeochemistry and living resource communities in the next phase of planning for the ocean observing system.

Observing System Meetings/Workshops led or attended FY07

Oct JCOMM Mgmt Committee-V GVA
Oct Global Climate Observing System SC GVA
Nov JCOMM Services Coord Gp Exeter
Nov Global Ocean Observing System Regional Forum III CapeTown
Nov Autumn COSC DC
Dec SCOR Coordination Mtg London
Jan Partnership for Observations of the Global Ocean-8 Qingdao
Mar GOO Science Steering Committee Seoul
March WCRP Joint Scientific Committee Zanzibar Tanzania
April Atmospheric Observation Panel for Climate GVA
April OOPC-XII Paris
May Bonn German Climate modeling review panel
Jun Office Climate Observations annual review and Spring COSC
Jun IGOOS -8 Paris
July Ocean09 planning Paris
Aug IGODAE Steering Team St John's Newfoundland
Aug ClimateTest Bed SAB DC
Sept CLIVAR SSG Geneva
Sept 2nd ocean reanalysis MIT

Publications

Bond, N.A. and D.E. Harrison (2006) ENSO's Effect on Alaska during Opposite Phases of the Arctic Oscillation.U.S. International Journal of Climatology 26, 1821-1841.

Harrison, D.E. and M. Carson (2007) Is the World Ocean warming? Upper Ocean Temperature Trends, 1950-2000 JPO 37(2), 174-187.

Chiodi, A.M. and D.E. Harrison (2007), Mechanisms of summertime subtropical southern Indian Ocean sea surface temperature variability: on the importance of humidity anomalies and the meridional advection of water vapor. J. Climate 20(19), 4835-4852

Harrison, D. E. and M. Carson (2008). Is the upper ocean warming? Comparison of 50yr trends from different approaches. To appear (Journal of Climate)

Chiodi, A.M. and D.E. Harrison (2008), Hurricane alley SST variability in 2005 and 2006. Submitted to J Climate

Harrison, D.E. and A.M. Chiodi (2008) Pre and Post 97/98 westerly wind events and equatorial Pacific cold tongue warming. Submitted to J. Climate.

Appendix of Acronyms

CEOF	Complex Empirical Orthogonal Function
CLIVAR	Climate Variability program (WCRP)
COOP	Coastal Ocean Observations Panel (GOOS)
DOE	Dept of Energy
ECMWF	European Centre for Medium-Range Weather Forecasting
EOF	Empirical Orthogonal Function
FAO	Food and Agriculture Organization (UN)
GCOS	Global Climate Observing System (WMO/IOC/FAO)
GLOS	Global Sea Level Observing System (JCOMM)
GODAE	Global Ocean Data Assimilation Experiment of OOPC
GOOS	Global Ocean Observing System of IOC
IOC	Intergovernmental Oceanographic Commission
IOOS	Integrated Ocean Observing System (US)
JCOMM	Joint Commission on Oceanography and Marine Meteorology
LLNL	Lawrence Livermore National Laboratory
LAS	Live Access Server
MAN	Management Committee (JCOMM)
MJO	Madden-Julien Oscillation
NCEP	National Centers for Environmental Prediction
NODC	National Oceanographic Data Centre
NRC	National Research Council
OOPC	Ocean Observations Panel for Climate (GOOS/GCOS/WCRP)
OpenDAP	Data protocol
POGO	Partnership for Global Oceanography
SCOR	Scientific Committee for Ocean Research
SLP	Sea Level Pressure (also MSLP)
SST	Sea Surface Temperature
TMI	TRMM Microwave Imager
TRMM	Tropical Rainfall Measurement Mission
WCRP	World Climate Research Program
WWE	Westerly Wind Event